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A CASE IN WHICH THE SPINAL CORD OF A  
RABBIT WAS SUCCESSFULLY USED AS A  
GRAFT IN THE MEDIAN NERVE  
OF A MAN.

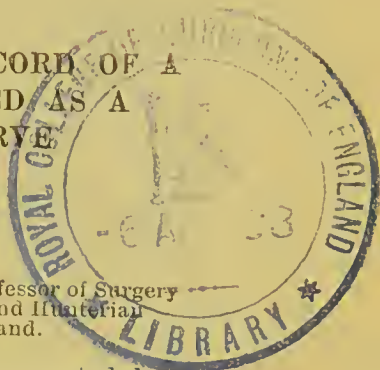
By MAYO ROBSON, F.R.C.S.,

Senior Surgeon to the General Infirmary at Leeds; Professor of Surgery  
in the Yorkshire College of the Victoria University; and Honorary  
Professor, Royal College of Surgeons of England.

THE following case, which I have hitherto not reported, but which I intended to describe at the International Medical Congress in Berlin, will, I think, be found to present several points of interest; and the delay in reporting it will, I trust, have enhanced the value of the present paper, since I am able to give a description of the case after an interval of six years.

In February, 1889, I read a paper before the Clinical Society of London on a case of nerve grafting, which was, I believe, the first case in which the operation had been carried out in the human subject. Although it was difficult to explain the rapid return of function in the arm after the operation, there could be no question as to the result, which, from a report received three years afterwards, had become perfect. In July, 1890, my colleague, Mr. Atkinson, read an extremely interesting paper on the subject at the annual meeting of the British Medical Association in Birmingham, in which he described two cases of his own, and at the same time mentioned two cases of mine and one of Mr. Ward's, all of which were at the time of being reported progressing satisfactorily towards complete recovery.

The case I have to describe is as follows: W. R., aged 29, a gardener, was admitted to the Leeds Infirmary under my care on January 18th, 1890, having been sent to me by Dr. Mackay, of Hornby. He gave the history of having seven months ago fallen on a scythe, which had produced a deep incision on the lower and inner part of the upper arm, the brachial artery being divided. At the time of injury a surgeon was sent for; the artery was ligatured, and the two ends of a divided nerve were sutured. The wound healed slowly by granulation. On admission to the infirmary, the patient was in robust health. There was a scar on the inner aspect of the right arm, extending from a point 2 inches above and to the inner side of the olecranon process, obliquely upwards and forwards for about 3 inches to the inner side of the prominence of the biceps. The circumference of the right forearm was two-thirds of an inch less than that of the left, that of the wrist half an inch less. The hypothenar eminence was absent, the thenar eminence was much atrophied, and the



interossei muscles were very much wasted. He had entirely lost the power of grasping, though he could flex the metacarpophalangeal articulations to a right angle. Extension of the wrist was possible, apparently with considerable exertion, but flexion of the wrist was impossible against gravity. The thumb could not be adducted nor the fingers separated or approximated. All the muscles acting on the wrist and hand which had their nerve supply from the median and ulnar nerves were paralysed, while those supplied by the musculo-spiral were capable of acting.

Sensation was absent along a narrow line extending over the inner and anterior aspect of the ulnar border of the forearm from the elbow to the wrist. In the palm sensation was absent except over the thenar eminence and part of the proximal phalanx of the thumb. On the back of the hand it was absent, internal to a line drawn backward from the cleft of the middle and ring fingers, also over the whole of the back of the little and ring fingers, as well as over the distal one and a half phalanges of the index and middle fingers.

#### ELECTRICAL REACTION.

The extensors reacted to faradism; the flexors showed no reaction. To a current of 10 M.A.P., the C.C.C. was greater than the A.C.C., both in the flexors and extensors. It was manifest that there had been a complete division of the median, ulnar, and internal cutaneous nerves, and it was clearly useless to attempt anything short of operative interference.

On January 30th, 1890, the limb having been previously asepticated, ether was administered, and an incision made along the line of the cicatrix, it being prolonged some distance upwards and downwards, and supplemented by a transverse incision about an inch above the elbow. The ulnar nerve was soon exposed above the internal condyle, it being firmly fixed in fibrous tissue. The lower end of the upper segment, which was bulbous, was connected by fibrous tissue with the upper end of the lower segment. A long search then took place for the median nerve, as the large cicatrix had altered the normal anatomy of the parts. A small nerve was discovered at the upper part of the wound, which proved to be the internal cutaneous. The lower end of this nerve was discovered later, and united to the upper by a catgut suture. The internal intermuscular septum was divided  $1\frac{1}{2}$  inch above the internal condyle, and the atrophied remains of the brachial artery defined. At last, about the middle of the upper arm, the bulbous lower end of the upper segment of the median nerve was discovered well under and concealed by the belly of the biceps. Later the upper end of the lower segment was found just above the bend of the elbow. This extremity was expanded and sent ramifications into the cicatrix. The fibrous tissue between the ends of the ulnar nerve was excised, and the two healthy portions were united by grafting strands of the sciatic nerve of a rabbit so as to fill up the gap and produce continuity. It was quite impossible to bring the divided ends of the median nerve nearer than  $2\frac{1}{2}$  inches. All the nerve tissue at my disposal having been exhausted in uniting the ulnar nerve, Mr. Littlewood, who was assisting me, dissected out the spinal cord of a rabbit just killed, and this was used as a graft to connect the ends of the median nerve, the inserted cord lying loose and quite free from

tension when finally placed in position. Fine catgut sutures were used throughout. The edges of the wound were brought together and the usual dressings applied, the arm being fixed on a rectangular splint. Healing occurred by first intention, and there was an entire absence of fever or pain.

On February 10th the patient could feel the scratch of a pin on the flexor aspect of the first phalanx of the thumb, as well as at the root of the index finger. He could tell when the hairs on the back of the first phalanges of the ring and little fingers were pulled, but could not feel the scratch of a pin in that position.

On February 17th sensation had returned over the whole of the palmar surface of the thumb and the proximate phalanx of the index finger.

On March 4th sensation seemed to be creeping slowly along the first finger, and to be present over the whole of the palmar area supplied by the median nerve, and extending as far down as the web of the fingers, and a short distance along the middle finger. As yet there was no marked improvement in the ulnar distribution.

On March 6th electrical reaction to faradism was absent in the muscles. C.C. 15 M.A.P.; C.C.C. equal to A.C.C. in flexors; C.C.C. greater than A.C.C. in extensors.

The muscles were gradually developing, and the general nutrition of the hand showed improvement. There was a slight power of grasp and some power of flexion of the wrist, as well as slight power of adduction of the thumb and flexion of the fingers. Sensation was felt all over the thumb and index finger, in the second finger up to the first phalanx on the palmar aspect, also in the third finger, though less distinct. No sensation could be elicited over the distribution of the ulnar nerve.

On March 30th he began to have sharp shooting pains along the distribution of the ulnar nerve.

On April 1st the flexors of the forearm began to react visibly to C.C.C., though the muscles of the thenar eminence did not, and there was no faradic reaction.

On April 30th sensation was returning at the back of the ring finger, and the flexors now reacted to A.C.C. of 5 M.A.P.

On June 13th the nutrition of the hand was much improved, and there was a greater feeling of warmth in it. He could pick up small objects, and although the grasp was not powerful, it was much improved. The powers of flexion of the wrist and adduction of the thumb were considerably increased, but there was no sensation as yet over the ulnar distribution.

Being interested in the case I made inquiries from time to time after he left Leeds, but I never saw him again until February, 1896, six years after the operation, when I asked him if he would let me demonstrate his case at the Leeds and West Riding Medico-Chirurgical Society, where my colleagues and other members of the Society had the opportunity of seeing him. Dr. Mackay had applied galvanism to the muscles of the forearm and hand from time to time, from the time of his leaving Leeds until the middle of November of the same year, when all treatment was stopped. He did not resume work till March, 1891, not because he was unable to undertake light work, but as the patient put it, "he wanted to give the arm a fair chance of complete recovery." Since



March, 1891, he had not missed a single day's employment, and was able to do all his duties completely, from wheeling a well-laden barrow to using a scythe.

*Condition of the Patient when seen in February, 1896.*—There was a firm round scar along the inside of the arm. The circumference of the right forearm was 11 in.; left forearm, 11½ in.; right wrist, 7 in.; left wrist, 7½ in.

From these measurements it will be seen that the muscles had almost completely returned to their former volume, and in the hand all the muscles except the abductor of the thumb were as well developed as in the left, this being quite as well marked in the interossei as in the other muscles. The movements of the arm were completely restored, and almost as perfect as in the left. Flexion of the fingers and the grasp had completely returned, and the only weak muscle was the abductor of the thumb, which had no perceptible power. Sensation was completely restored, as was easily demonstrated by touching the different portions of the arm and hand with a pin.

*Electrical Reaction.*—All the muscles of the arm and hand reacted to faradism except the abductor of the thumb.

REMARKS.—It will thus be seen that though the recovery had been tardy, it was complete in almost every respect, the only exception being that of the abductor pollicis which for some unexplained reason did not recover its function. The case is very encouraging, since it clearly demonstrates the possibility of restoring continuity of nerves by grafting. Whether the spinal cord in this case took up the functions of a nerve, or whether it simply served as a basis on which the nerve tissue was built up, I am quite unable to say. But that it did answer its purpose is clearly shown in the report of the case. Why restoration of function in the ulnar nerve should have been longer than in the median, I am unable to say, as the ends of the nerve were not separated more than  $\frac{3}{4}$  of an inch, whereas the ends of the median nerve were between 2 and 3 in. apart. Could it be that the spinal cord offered a better medium for establishing continuity?

When in February, 1889, I related before the Clinical Society a fact (about which there could be no doubt), that after grafting a portion of the posterior tibial nerve of a man into a gap in the median nerve of a girl, sensation had returned in the fingers supplied by the median nerve within thirty-six hours after the operation, I could see that the statement was received with some incredulity. The observation, however, was made in a public institution, and there confirmed by others who had no interest in the case, so that I am able to vouch for its accuracy. The same remarks apply with regard to the observations in the present case, and I think it will be granted that both cases give much food for thought.

I feel sure that we have still much to learn concerning the repair of nerve lesions, and I am not at all certain that the conclusion of physiologists is correct when they affirm that the peripheral portion of a divided nerve always undergoes atrophy.